U.S. Department
of Transportation
**Federal Aviation**
**Administration**

# Advisory Circular

**Subject:** AIRCRAFT FIRE EXTINGUISHING AGENTS

**Date:** DRAFT **AC No:** 150/5210-6D

**Initiated by:** AAS-100 **Change:**

**1. PURPOSE.** This Advisory Circular (AC) provides guidance for reference material covering Aircraft Fire Extinguishing Agents.

**2. CANCELLATION.** Advisory Circular 150/5210-6C, dated January 28, 1985, is cancelled.

**3. APPLICATION.** The Federal Aviation Administration (FAA) recommends the guidelines contained in this AC for Aircraft Fire Extinguishing Agents. This AC is not mandatory and does not constitute a regulation. However, the information it contains provides an acceptable methodology for complying with 14 Code of Federal Regulations (CFR), PART 139, *Certification and Operations: Land Airports Serving Certain Air Carriers*. In the event of a conflict, PART 139 takes precedence over the other documents identified in this AC.

**4. APPLICABLE DOCUMENTS.**

The following documents are applicable to the extent specified in this AC:

**4.1 Code of Federal Regulations (CFR).**

14 CFR PART 139, *Certification and Operations: Land Airports Serving Certain Air Carriers*.

**4.2 National Fire Protection Association (NFPA).**

NFPA 403, *Standard for Aircraft Rescue and Fire-Fighting Services at Airports,* August 7, 2003, edition.

NFPA 412, *Standard for Evaluating Aircraft Rescue and Fire-Fighting Foam Fire Equipment*, 2003 edition.

**4.3 Military Specifications.**

MIL-F-24385F, *Fire Extinguishing Agent, Aqueous Film Forming Foam (AFFF) Liquid Concentrate, for Fresh and Seawater*, dated January 7, 1992.

**4.4 Underwriters Laboratory (UL) Standards.**

UL 162, *Standard for Safety for Foam Equipment and Liquid Concentrate,* dated March 30, 1994.

**5. HOW TO ORDER.**

a. Copies of PART 139 may be purchased from:

Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402

b. Copies of National Fire Protection Association (NFPA) Standard No. 403, *Standard for Aircraft Rescue and Fire-fighting Services at Airports*, and Standard No. 412, *Standard for Evaluating Aircraft Rescue and Fire-Fighting Foam Fire Equipment*, may be ordered from

National Fire Protection Association
1 Batterymarch Park
Quincy, MA 02269

c. Copies of UL 162, *Standard for Safety for Foam Equipment and Liquid Concentrates,* can be purchased from

Underwriters Laboratory, Inc.
Customer Service
1285 Walt Whitman Road
Melville, NY 11747-3081

d. A printed copy of this and other ACs can be ordered from

U.S. Department of Transportation
Subsequent Business Office
Annmore East Business Center, 3341 Q 75th Avenue
Landover, MD 20785

e. Electronic copies of FAA ACs and PART 139 may be obtained from

Internet: http://www.faa.gov/arp

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# CHAPTER 1. BACKGROUND.

## 1.1 GENERAL.

This AC provides reference information on the following agents:

- Primary aircraft fire extinguishing agents
- Supplementary aircraft fire extinguishing agents
- Other aircraft fire extinguishing agents

## 1.2 DEFINITIONS.

### 1.2.1 Primary Agents.

Foam used for extinguishing aircraft fires should consist of an aggregation of bubbles of a lower specific gravity than that of hydrocarbon fuels or water. The foam should have strong cohesive qualities and be capable of covering and clinging to vertical and horizontal surfaces. Aqueous foam cools hot surfaces by its high water retention ability and must flow freely over a burning liquid surface to form a tough, air-excluding blanket that seals off volatile flammable vapors from access to air or oxygen. Good-quality foam should be dense and long lasting, capable of resisting disruption by wind or draft, stable to intense thermal radiation, and capable of re-sealing in event of mechanical rupture of an established blanket.

#### 1.2.1.1 Aqueous Film Forming Foam (AFFF).

These liquid concentrates consist of perfluorinated surfactants(s) with a foam stabilizer, suitable freezing point depressants, and viscosity control agents. The AFFF acts both as a barrier to exclude air or oxygen and, in addition, produces an aqueous film on the fuel surface capable of suppressing the evolution of fuel vapors. Ideally, the foam blanket produced by the AFFF should be of sufficient thickness so as to be visible before fire fighters rely on its effectiveness as a vapor suppressant.

#### 1.2.1.2 Fluoroprotein Foam (FP).

Fluoroprotein Foam falls broadly into two subtypes. One has concentrations of a synthetic fluorinated surfactant for the purpose of providing resistance to breakdown by dry chemical powders, and the other type has concentrations of a surfactant sufficient to produce an aqueous film on the surface of hydrocarbon fuels. Both types can be used to produce suitable foam, but the manufacturer of the foam-making equipment should be consulted as to the correct concentrate to be used in any particular system (the proportioners installed must be properly designed and/or set for the concentrate being used).

#### 1.2.1.3 Film Forming Fluoroprotein (FFFP) Foam.

These agents are also based on protein foam formulations. They are produced by increasing the quantity and quality of the fluorocarbon surfactants added to the protein hydrolyzate. By doing this, the surface tension of the resulting solution that drains from the expanded foam is reduced to the point that it can spread across the surface of a liquid hydrocarbon fuel.

#### 1.2.1.4 Protein Foam.

These liquid concentrates consist primarily of hydrolysis products of various proteinaceous materials. They also contain stabilizing additives and inhibitors to protect against freezing, to prevent corrosion of equipment and containers, to resist bacterial decomposition, to control viscosity, and to assure readiness for use in emergencies. Foam liquids of different types or different manufacturers should not be mixed unless it is determined that they are compatible and/or completely interchangeable. Although compatibility can be attained by using a dry chemical listed and intended for dual use, most protein foam is not compatible with most dry chemical powders.

### 1.2.2 Supplementary Agents.

Supplementary agents are also referred to as secondary agents. Agents that fit into this category are carried on rescue vehicles to handle unique fire fighting requirements most common to airport fire fighting use. Supplementary agents are employed either singly or in combination with foam to accomplish particular aircraft fire fighting operations such as a three dimensional running fuel fires (reference NFPA 403, Annex A, § A.5.2 (1)).

This class of agents include—

- Dry Chemical Powders
- Halotron® I
- Carbon Dioxide

#### 1.2.2.1 Dry Chemical Powders.

The earliest use of dry powders in aircraft fire fighting included the use of sodium bicarbonate-based products. Today, the U.S. airport fire fighting industry relies almost exclusively on the use of potassium-based chemicals as auxiliary extinguishing agents due to their compatibility with AFFF agents and their reliable fire performance.

#### 1.2.2.2 Halotron® I.

Subsequent to the U.S. decision to halt production of halon as part of the Montreal Protocol (reference NFPA 403, Appendix A, §A.5.2 (2)) and the use of halon-based agents (e.g., Halon 1211) in live fire training because of its environmental effects, the FAA teamed with other agencies and industry and identified an acceptable alternative to using halon-based agents in airport rescue firefighting vehicles. Several potential agents were evaluated. Only the Halotron® I product has completed the full-scale fire test performance evaluation and was approved as an alternative fire fighting agent to Halon 1211 for airport fire fighting use. Due to the slight differences in specific gravity of these two chemicals in a 1:1 by-volume basis, approximately 468 pounds of Halotron® I can be placed in the existing vessel (tank) that holds approximately 500 pounds of Halon 1211. This is the quantity that can normally be found on an airport rescue and fire fighting vehicle. Fire performance tests have shown that Halotron® I will generally suppress or extinguish fires in the same manner as Halon 1211. In considering the substitution of Halotron® I for Halon 1211, the ratio for equivalency in performance might be as great as 1.5 to 1 pound by weight.

#### 1.2.2.3 Carbon Dioxide.

Tests show that low-pressure carbon dioxide ($CO_2$) is more effective in aircraft rescue and fire fighting operations than high pressure $CO_2$. The tests further indicate that $CO_2$ can be given parity with dry chemical powder on the basis of 4.4 pounds of $CO_2$ gas per 2.2 pounds of dry chemical.

### 1.2.3 Other Agents.

In general there are other special-use fire extinguishing agents available to airport firefighting services. In particular, those agents used to combat Class D fires, such as magnesium fires, are referred to as combustible metal agents. For information on these agents, refer to NFPA 403 Annex A, §A.5.5.

### 1.2.4 Theoretical Critical Fire Area (TCA).

The TCA is the area adjacent to an aircraft that when exposed to heat, is tolerable to human skin and allows for passenger self-evacuation.

The International Civil Aviation Organization (ICAO) Rescue and Fire Fighting Panel (RFFP) developed what is considered a working definition of the TCA. According to the RFFP, in this area, the fire must be controlled to ensure temporary fuselage integrity and provide an escape area for aircraft occupants.

The TCA serves as a means of categorizing aircraft in terms of the magnitude of the potential fire hazard in which they may become involved. It is not intended to represent the average, maximum, or minimum spill fire size associated with a particular aircraft. For information on TCA, refer to NFPA 403, Annex B, §B.1.1.

### 1.2.5 Practical Critical Fire Area (PCA).

In a survivable aircraft crash, the Practical Critical Fire Area is smaller than the TCA.

The PCA and the related quantities of extinguishing agents are based on criteria formulated during the Second Meeting of the ICAO Rescue and Fire Fighting Panel (RFFP II) in June 1972. RFFP II developed material indicating the practical area is two-thirds of the theoretical area based on the Panel's work, which included a study of extinguishing agents used on actual aircraft fires. In 99 out of 106 studied fires, the quantities of agents used were less than those previously recommended by ICAO, substantiating the requirement recommended in this AC for reduced quantities. For information on PCA, refer to NFPA 403, Annex B, §B.1.1.

### 1.2.6 Control Time.

The control time is the time required from the arrival of the first fire fighting vehicle and the beginning of agent discharge to reduce the initial intensity of the fire by 90 percent. The equipment and techniques to be used should be capable of controlling the fire in the PCA in 1 minute. For information on control time, refer to NFPA 403, Annex B, §B.2.

### 1.2.7 Extinguishment Time.

Extinguishment time is the time required from the application of the agent of the first fire fighting vehicle to the time the fire is extinguished. For information on extinguishment time, refer to NFPA 403, Annex B, §B.2.

## CHAPTER 2. QUANTITIES FOR AIRPORTS SERVING DOT-CERTIFICATED AIR CARRIERS/COMMERCIAL SERVICE.

PART 139 §139.315 is to be used to determine the aircraft rescue and firefighting Index (A through E) for airports serving Department of Transportation (DOT) certificated air carriers/commercial service. These numbers can then be converted to NFPA categories using NFPA 403, Chapter 4, Table 4.3.1. The extinguishing agents, quantities, and discharge and response capability for each Index is referenced in NFPA 403, Chapter 5, Table 5.3.1 (b), in U.S. customary units. NFPA 403, Annex B, additionally describes the methodology used to arrive at the designated control times (§B.2), discharge rates (§B.3), and quantities of agents to be provided (§B.4 and §B.5).

## CHAPTER 3. QUANTITIES FOR GENERAL AVIATION AIRPORTS.

The Indexes for general aviation airports are identified in NFPA 403, Chapter 4, Table 4.3.1. The extinguishing agents, quantities, and discharge and response capability for those Indexes are referenced in NFPA 403, Chapter 5, Table 5.3.1 (b), in U.S. customary units. NFPA 403, Annex B, additionally describes the methodology used to arrive at the designated control times (§B.2), discharge rates (§B.3), and quantities of agents to be provided (§B.4 and §B.5).

## CHAPTER 4. COMPATIBILITY OF AGENTS.

The compatibility of agents is discussed in NFPA 403, Chapter 5, §5.4.

## CHAPTER 5. EXTINGUISHING AGENT SUBSTITUTES.

Extinguishing agent substitutes are discussed in PART 139, §139.317 (i).

## CHAPTER 6. PERFORMANCE REQUIREMENTS.

AFFF agents must meet the requirements of Mil-F-24385F. It is important to note that if one vendor's foam is mixed with another vendor's foam in the re-servicing process, there must be compatibility between foams to prevent gelling of the concentrate.

When used, FFFP, FP, and protein foam must meet the applicable performance requirements discussed in UL 162 (Type 3 application), *Standard for Safety for Foam Equipment and Liquid Concentrates*.

## CHAPTER 7. TESTING AND QUALITY ASSURANCE.

### 7.1 QUALITY CONTROL.

While it is recognized that acceptance testing of extinguishing agents is necessary, the technical characteristics, quality, stability compatibility, etc. cannot be determined during other system tests or demonstrations (e.g., for trucks). Therefore, airport management should request that prospective bidders or suppliers of fire extinguishing agents furnish proof of tests on performance and quality by a recognized testing laboratory. Technical data on the evaluation of agents and information on the characteristics of foam extinguishing agents are contained in NFPA 412, Chapter 5.

**7.2 RESPONSIBILITY FOR INSPECTION.**

Unless specified by the airport owner, the manufacturer is responsible for the performance of all inspection requirements. Unless specified in the contract, the manufacturer may use his/her own or any other facilities suitable for the performance for the inspection requirements.

## APPENDIX A. RELATED FAA ADVISORY CIRCULARS.

AC 150/5210-7, *Aircraft Rescue and Firefighting Communications*

AC 150/5210-14, *Airport Fire and Rescue Personnel Protective Clothing*

AC 150/5210-17, *Programs for Training of Aircraft Rescue and Firefighting Personnel*

AC 150/5220-10, *Guide Specification for Water/Foam Aircraft Rescue and Firefighting Vehicles*

AC 150/5220-19, *Guide Specification for Small Agent Aircraft Rescue and Fire Fighting Vehicles*

AC 150/5300-13, *Airport Design*, Appendices 12 and 13